Description

Method for improving a load distribution in a signaling network

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The present invention relates to a method for improving a load distribution in a signaling network, and in particular to what is referred to as a load sharing method in which signaling messages are

10 uniformly distributed in a signaling network.

Communications networks generally connect two subscriber terminals to one another over a plurality of line sections and switching equipment for the exchange of messages (for example voice, data, text or images).

15 In the control of the connections and in the application of services, control information has to be transmitted here between the switching offices. In particular digital, computer-controlled communications networks provide a significantly greater range of

20 services in comparison with analog communications networks, for which reason a new high-capacity signaling system has been introduced in digital, computer-controlled communications networks.

The CCITT (now ITU, International Telecom-

25 munication Union) has therefore specified the central signaling system No. 7 (CCS7) which is optimized for use in digital networks.

In contrast to the previously customary channel-bound signaling, in the CCS7 the signaling

30 messages are conducted over separate signaling routes or signaling lines (links). A plurality of signaling lines (links) form here a signaling line group (link set, LS), a signaling line group (link set) having at maximum 16 signaling lines (links). A signaling route,

35 i.e. signaling link or signaling line group can

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transport the signal messages here for a large number of user information channels (trunks).

The signaling routes or signaling line groups (link sets, LS) of the CCS7 connect message transfer
5 parts (MTP) to one another in a communications network. The message transfer parts and the signaling line groups thus form an independent signaling network which is superimposed on the user information channel network. The signaling end points are the sources and
10 sinks of the signaling traffic and are primarily implemented in a communications network by the switching offices. Here, the message transfer parts (MTP) pass on received signaling messages to another message transfer part (MTP) or to a signaling end point
15 using a destination address (destination point code, DPC). No switching processing of the signaling messages takes place in a message transfer part (MTP). A message transfer part can be integrated in a signaling end point (for example a switching office) or form a
20 separate node in the signaling network. One or more levels of message transfer parts are possible depending on the size of the signaling network.

All the signaling points in a predefined signaling network are characterized within the
25 framework of a numbering plan, defined by the ITU (International Telecommunication Union), by, for example, a 14 point code (PC), and can thus be selectively addressed in a message signaling unit (MSU).
30 As well as, for example, a destination address (destination point code, DPC) and a source address (origin point code, OPC), a speaking circuit address (circuit identification code, CIC) is stored in the message signaling unit (MSU) transmitted in the
35 signaling network. According

to the ITU standard, this speaking circuit address CIC
has 12 bits, the least significant bits being referred
to as signaling link selection field (SLS). According
to ITU, predetermined signaling routes via the
5   signaling link selection field (SLS values) are
assigned to the various message signaling units (MSU).

Figure 5 shows a schematic view of a
conventional signaling network. The reference symbols
A, B, C, D, E, F show message transfer parts (MTP) of
10   respective switching offices which are connected to one
another via signaling line groups LS (link sets).
According to figure 5, the message transfer part A
designates a source address (origin point code, OPC)
and the message transfer part (MTP) F designates a
15   destination address (destination point code, DPC). In
the conventional signaling network according to figure
5, message signaling units can be transmitted via
various signaling line groups LS to the destination
point F (routing). In order to generate a uniform load
20   in the signaling network, all the message signaling
units with a signaling link selection field SLS=XX00
are conducted via the route A → B → D → F here
according to figure 5. The message signaling unit (MSU)
with the SLS values XX10 are conducted via a route
25   A → C → D → F. In the same way, the message signaling
units (MSU) with an SLS value of XX01 and SLS value
XX11 are conducted via the routes A → B → E → F or
A → C → E → F. This example relates to the normal
state of a CCS7 network without the inclusion of
30   network elements which may have failed (reference ITU
Q.705, Annex A). However, because, according to the
ITU, the SLS values cannot be changed within a message
signaling unit (MSU) and the network is composed of a
plurality of message transfer parts (MTP) which use the
35   same load distribution rules for the SLS values, there
is often a state in which signaling lines (links) or
signaling line groups (link sets, LS) are empty or do

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not have much data assigned to them. As a result, an
unequal distribution of load is generated.

This problem becomes more difficult if, instead
of the two signaling line groups LSA1 and LSA2
5 according to figure 5, suddenly four signaling line
groups are connected to a message transfer part (MTP)
and are used simultaneously for transporting the MSUs
in the load distribution method.

Figure 6 shows a schematic view of a further
10 conventional signaling network in which four signaling
line groups (link sets) LS1, LS2, LS3 and LS4 are
connected to a message transfer part (MTP).
Accordingly, when there are four signaling line groups
(link sets), two bits of the signaling link selection
15 field (SLS) must be used in the speech circuit address
(CIC) of the message signaling unit (MSU) in order to
select a line group from the four available signaling
line groups. As a result, when there is a load
distribution (load sharing) over four signaling line
20 groups LS, only four SLS values are then received at
the adjacent message transfer part (MTP), which in turn
signifies problems in the further load distribution
within a signaling line group for the respective
signaling lines.
25

According to figure 6, the reference symbol OPC
designates a message transfer part from which message
signaling units are to be transmitted via signaling
line groups LS1, LS2, LS3 and LS4. The reference
30 symbols X1, X2, X3 and X4 designate further message
transfer parts (MTP) which are, for example, integrated
into switching offices and constitute part of the
signaling network. The message transfer parts X1-X4
have, in the same way as the message transfer part OPC,
35 four signaling line groups (link sets) with which there
is a respective connection to the destination addresses
(DPC) or message transfer parts Y1, Y2, Y3 and Y4.
Usually, the message transfer parts OPC and X1-X4 have
the same load distribution rules, according to which
40 message signaling units (MSU) with the SLS values 0-3

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are passed on to a signaling line group LS1, MSUs with SLS values 4-7 are passed on to

a signaling line group LS2, MSUs with SLS values 8-11 are passed on to a signaling line group LS3, and MSUs with SLS values of 12-15 are passed on to a signaling line group LS4. However, this application of identical

5   load distribution rules leads to an unequal load distribution in the signaling network even in the message transfer parts X1-X4 and their associated signaling line groups. To be more precise, in the signaling network according to figure 6 there is heavy

10   loading for in each case just one of a sum of four signaling line groups, here for example the line groups LS(x1,y1), LS(x2,y2), LS(x3,y3) and LS(x4,y4), while the other signaling line groups are loaded to a lesser degree.

15   As the number of the signaling line groups involved in the load distribution method on the respective message transfer routes increases, there is a further worsening of the load distribution in the signaling network. However, because the signaling lines

20   or signaling line groups in the signaling network constitute extremely expensive data lines, such an unequal load distribution is extremely uneconomical.

In order to eliminate such cases of unequal loading in a signaling network, there have been

25   hitherto purely manual remedies, in which the inadequate load distribution in the signaling network is corrected by means of an operator intervention (man machine language command).

A further disadvantage with conventional load

30   distribution methods is manifest when there is a sum failure of a signaling line group. Here, there is usually a complete switchover to an available signaling line group irrespective of an actual load distribution, as a result of which in turn undesired shifts could

35   occur in the load distribution of the signaling network.

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The invention is therefore based on the object of providing a method for improving a load distribution in a signaling network which can be used cost-effectively to the same extent in any message transfer part.

In addition, the invention is based on the object of implementing a uniform distribution of a load in the signaling network when a signaling line group fails.

This object is achieved according to the invention with the measures of patent claims 1 and 5.

Each signaling line group is preferably assigned a predetermined number of route meters which corresponds to the number of actual routes, a deviation of the individual meters being kept as small as possible. As a result, a balanced load distribution of the message signaling units among the respective signaling line groups is obtained for all the actual routes.

On the other hand, it is possible to provide for each signaling line group precisely one summation meter which represents a number of used signaling line groups in actual routes and is compared with other summation meters. In this way, the load distribution in the respectively used signaling line groups can compensate each other.

The methods described above are preferably combined with one another, as a result of which a particularly balanced load distribution in the signaling network is obtained.

Advantageous refinements of the invention are characterized in the subclaims.

The invention is described in more detail below by means of exemplary embodiments and with reference to the drawing,

in which:

figure 1 shows a schematic view of a signaling network;

figure 2 shows a flowchart of a method for improving a load distribution in a signaling network according to a first exemplary embodiment;

figure 3 shows a flowchart of a method for improving a load distribution in a signaling network according to a third exemplary embodiment;

figure 4 shows a flowchart of a method for improving a load distribution in a signaling network according to a fourth exemplary embodiment;

figure 5 shows a schematic view of a conventional signaling network; and

figure 6 shows a schematic view of a further conventional signaling network.

The basic idea of the present invention consists in performing a message transfer part (MTP) load distribution by means of signaling line groups (link sets) not only on the basis of the signaling link selection field (SLS field) described above, in a message signaling unit (MSU) as in the ITU standard but also to determine the load distribution in a coordinated way for all the destination addresses (DPC) in a database.

The load distribution over signaling line groups (link sets) is determined in advance by a message transfer part network manager (MTP network management) and made available to a message transfer part routing system (MTP routing). These calculations are carried out not only selectively per destination address

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(destination point code, DPC), but are matched to one another automatically for all the destination addresses. In this way, subsequent load distribution rules, for example load distribution within a signaling

5 line group in its own switching office and load distribution in the adjacent switching offices, have ideal conditions because again all 16 SLS values are available. Furthermore, with a load distribution over four signaling line groups (link sets) there is the

10 further advantage that the equivalent network circuits are apportioned better.

In principle, a load distribution method functions satisfactorily, best, if all 16 SLS values are available at the input of the method. In this way,

15 a good load distribution can then be generated at the output of the method. In order to achieve this, coordination should be carried out within the entire network in such a way that as far as possible all the message transfer parts ensure that as far as possible

20 all 16 SLS values are transmitted over a signaling line group.

The invention is described in more detail below with reference to a first exemplary embodiment.

25 First exemplary embodiment

Figure 1 shows a schematic view of a signaling network in which the method according to the invention for improving a load distribution can be applied. The

30 reference symbol 1000 designates a switching office whose message transfer part (MTP) has the destination address 1000. In the same way, the reference symbols 2000 to 8200 each refer to respective switching offices with associated message transfer parts and

35 corresponding destination addresses 2000 to 8200. However, in the following exemplary embodiments, only the message transfer parts with the destination addresses (DPC) 6000, 7000, 8000, 8100 and 8200 are taken into account, while the message transfer parts

40 2000 to 5000 serve only for passing on

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the message signaling units MSUs to be transferred. The
message transfer part 1000 has a plurality of signaling
line groups LSx, of which in particular the signaling
line groups LS3, LS4, LS20 and LS50 are considered
5   below. The message transfer part 1000 has, for example,
routes which have already been activated to further
destination addresses in the signaling network, and has
the values illustrated in table 1 for the respective
route meters C(LSx,y) which are assigned to the
10   respective signaling line groups LS3, LS4, LS20 and
LS50.

Table 1

Route meters C(LSx,y) signaling line groups LSx	Y = 1 C(LSx,1)	y = 2 C(LSx,2)	y = 3 C(LSx,3)	y = 4 C(LSx,4)	C_Sum/m (number m CRs = 4) Csetp (LSx)
. . . . .					
. . . . .					
link set 3	5	6	4	5	5
link set 4	6	4	6	5	5.25
. . . . .					
link set 20	12	13	14	11	12.5
. . . . .					
link set 50	1	4	3	2	2.5
. . . . .					
. . . . .					

15

In table 1, the values for the respective
signaling line groups link set 3, link set 4, link set
20 and link set 50 refer to the respective meter
readings for the actual route (current route), four
20   actual routes (current route, CR) being assumed in
table 1. The last column refers to a setpoint meter
reading for the respective signaling line groups LSx.
The setpoint meter reading Csetp (LSx) results from the
division of the sum values for the route

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meter of a respective signaling line group LSx with the number m of actual routes or route meters CRy. In the example according to table 1, the number m for the route meters CRy is equal to 4, the number n for the signaling line groups LSx which are used also having the value 4.

An actual route (current route) is subsequently to be set up from the message transfer part 1000 to the destination address (DPC) 7000. Because the destination address (DPC) 7000 cannot yet be reached, there are no signaling line groups LSx (link sets) entered in the active actual routes (active current routes).

Table 2

CR1	CR2	CR3	CR4
LS ?	LS ?	LS ?	LS ?

The available signaling line groups LS3, LS4, LS20 and LS50 will now become actual routes (current routes) for the destination address (DPC) 7000. In order to obtain the most uniform possible load distribution over the actual routes (CR1, CR2, CR3 and CR4), an absolute deviation DELTA C (LSx,y) is firstly determined. For this, according to equation (1) a setpoint meter reading Csetp (LSx) is firstly determined for each signaling line group LSx to be used.

$$Csetp \ (LSx) \ = \ \Sigma C(LSx,y)/m, \hspace{3cm} (1)$$

C(LSx,y) representing the respective value of a route meter for a specific signaling line group LSx and a specific actual route CRy, and m indicating the number of actual routes CRy.

According to equation (2), the absolute deviation DELTA C(LSx,y) is obtained as

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$$\text{DELTA } C(LSx,y) = Csetp(LSx) - C(LSx,y) \qquad (2)$$

In order to generate an optimum load distribution for the first actual route CR1, a relative deviation of the individual meter readings must also be determined. According to equation (3), this relative deviation Delta Crel is obtained as

$$\text{Delta Crel } (LSx,y) = \text{DELTA } C(LSx,y) \text{ / } Csetp \qquad (3)$$

The result matrix for the calculated values of the absolute deviation DELTA $C(LSx,y)$ and of the relative deviation Delta Crel (LSx,y) are given in table 3.

Table 3

DELTA C(LS3,1) = 0	Delta Crel (LS3,1) = 0
DELTA C(LS3,2) = -1	Delta Crel (LS3,2) = -0.20
DELTA C(LS3,3) = +1	Delta Crel (LS3,3) = +0.20
DELTA C(LS3,4) = 0	Delta Crel (LS3,4) = 0
DELTA C(LS4,1) = -0.75	Delta Crel (LS4,1) = -0.14
DELTA C(LS4,2) = +1.25	Delta Crel (LS4,2) = +0.24
DELTA C(LS4,3) = -0.75	Delta Crel (LS4,3) = -0.14
DELTA C(LS4,4) = +0.25	Delta Crel (LS4,4) = +0.05
DELTA C(LS20,1) = +0.5	Delta Crel (LS20,1) = +0.04
DELTA C(LS20,2) = -0.5	Delta Crel (LS20,2) = -0.04
DELTA C(LS20,3) = -1.5	Delta Crel (LS20,3) = -0.12
DELTA C(LS20,4) = +1.5	Delta Crel (LS20,4) = +0.12
DELTA C(LS50,1) = +1.5	Delta Crel (LS50,1) = +0.60
DELTA C(LS50,2) = -1.5	Delta Crel (LS50,2) = -0.60
DELTA C(LS50,3) = -0.5	Delta Crel (LS50,3) = -0.20
DELTA C(LS50,4) = +0.5	Delta Crel (LS50,4) = +0.20

Here, the value 0 in table 3 signifies an ideal value, i.e. there is no deviation from the setpoint value. A positive value for the absolute and/or relative deviation signifies an "upward" deviation (setpoint value greater than the actual value), i.e. load should be added, while a negative value signifies a "downward" deviation (setpoint value smaller than the actual value), i.e. load should be reduced.

Because a load can only be added in the first exemplary embodiment (it is to be additionally possible to reach the destination address 7000), the values of the greatest possible deviation are always selected for each signaling line group LSx.

Because the value Delta Crel (LS50,1) = +0.60 constitutes the highest positive deviation, the signaling line group LS50 (link set 50) is entered into the actual route CR1. There are thus only still the actual routes CR2, CR3 and CR4 remaining to be assigned. The signaling line group LS50 can be used only once as an actual route CR, and is no longer taken into account in the further allocation.

Accordingly, the selection matrix according to table 4 is obtained for the search for the signaling line group LSx for the next actual route CRy.

Table 4

Delta Crel(LS3,1) = CR1 is already assigned
Delta Crel(LS3,2) = -0.20
Delta Crel(LS3,3) = +0.20
Delta Crel(LS3,4) = 0

Delta Crel(LS4,1) = CR1 is already assigned
Delta Crel(LS4,2) = +0.24
Delta Crel(LS4,3) = -0.14
Delta Crel(LS4,4) = +0.05

Delta Crel(LS20,1) = CR1 is already assigned
Delta Crel(LS20,2)/12.5 = -0.04
Delta Crel(LS20,3)/12.5 = -0.12
Delta Crel(LS20,4)/12.5 = +0.12

According to table 4, the value Delta Crel (LS4,2) = +0.24 has the highest positive deviation, for which reason the signaling line group LS4 is entered for the actual route CR2. Consequently, there are still only the actual routes CR3 and CR4 remaining to be assigned, and it is no longer permitted to use the signaling line group LS4.

The remaining selection matrix for the search for a signaling line group LSx for the next actual route CRy is thus obtained from table 5.

Table 5
  Delta Crel(LS3,1) = CR1 is already assigned
  Delta Crel(LS3,2) = CR2 is already assigned
  Delta Crel(LS3,3) = +0.20
  Delta Crel(LS3,4) = 0

  Delta Crel(LS20,1) = CR1 is already assigned
  Delta Crel(LS20,2) = CR2 is already assigned
  Delta Crel(LS20,3) = -0.12
  Delta Crel(LS20,4) = +0.12

According to table 5, the value Delta Crel (LS3,3) = +0.20 is the highest positive deviation, for which reason the signaling line group LS3 is entered in the actual route CR3, and only the remaining signaling line group LS20 is still available for the remaining actual route CR4, and is accordingly entered.

The active actual routes for the destination address (DPC) 7000 consequently have the distribution according to table 6.

Table 6

CR1	CR2	CR3	CR4
link set 50	link set 4	link set 3	link set 20

The route meters C(LSx,y) for the affected signaling line groups and actual routes, i.e. for C(LS50,1), C(LS4,2), C(LS3,3) and C(LS20,4), have now incremented by 1, while the remaining route meters remain unchanged. According to table 7, this results in an improved load distribution because the variance of the absolute and relative deviations is improved.

Table 7

```
Delta Crel (LS3,1)  = 0     → +0.05
Delta Crel (LS3,2)  = -0.20 → -0.14
Delta Crel (LS3,3)  = +0.20 → +0.05        Variance
Delta Crel (LS3,4)  = 0     → +0.05        -0.20/+0.20 → -0.14/+0.05


Delta Crel (LS4,1)  = -0.14 → -0.09
Delta Crel (LS4,2)  = +0.24 → +0.09
Delta Crel (LS4,3)  = -0.14 → -0.09        Variance
Delta Crel (LS4,4)  = +0.05 → +0.09        -0.14/+0.24 → -0.09/+0.09


Delta Crel (LS20,1) = +0.04 → +0.06
Delta Crel (LS20,2) = -0.04 → -0.02
Delta Crel (LS20,3) = -0.12 → -0.10        Variance
Delta Crel (LS20,4) = +0.12 → +0.06        -0.12/+0.12 → -0.10/+0.06


Delta Crel (LS50,1) = +0.60 → +0.27
Delta Crel (LS50,2) = -0.60 → -0.46
Delta Crel (LS50,3) = -0.20 → -0.09        Variance
Delta Crel (LS50,4) = +0.20 → +0.27        -0.60/+0.60 → -0.46/+0.27
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Figure 2 shows a flowchart of a method according to the invention for improving a load distribution according to the first exemplary embodiment.

5   According to figure 2, all the route meters used and other meter readings are initialized in a step S1 in order to set up an actual route CRy by means of what is referred to as a position method. In a step S2, a loop is connected for all n signaling line groups LSx

10   in actual route CRy, the method progressing to a step S6 only when all n signaling line groups LSx have been processed. In a step S3, a setpoint meter reading is calculated, a summation meter C_Sum(LSx) being firstly determined for each signaling line group LSx. The value

15   of the summation meter C_Sum(LSx) resulting here from the sum of all the values of the route meters C(LSx,y) for a specific signaling line group LSx. On the basis of this value, the setpoint meter reading Csetp(LSx) is determined by dividing the value of the summation meter

20   C_Sum(LSx) by a number m for the actual routes CR.

In a step S4, a loop is carried out for all m actual routes CRy, the method not jumping to the step S2 until all m actual routes CRy have been processed.

In a step S5, the relative deviations Delta

25   Crel (LSx,y) from the setpoint meter reading are calculated for each actual route CRy. Firstly, an absolute deviation DELTA C(LSx,y) is determined here for each actual route CRy which results from the difference between the setpoint meter reading

30   Csetp(LSx) and the value of the route meter C(LSx,y). The relative deviation Delta Crel (LSx,y) is then calculated by dividing the absolute deviation by the setpoint meter reading.

When the loops have been completely carried out in steps S2 and S4, a matrix of n × m relative deviation values, which are considered below, is obtained. In a step S6, a loop is carried out until all m actual routes CRy are assigned. The greatest relative deviation is then only determined in a step S7, from the matrix of n × m relative deviation values Delta Crel (LSx,y), in which case it is not permitted for an actual route CRy to have been assigned yet and a signaling line group LSx has not yet been allocated, or does not have a position in an actual route CRy. In a step S8, the signaling line group LSx which is thus found is then assigned to a corresponding actual route CRy. Finally, in a step S9 the corresponding route meter C(LSx,y) is updated or incremented by 1. The program ends with a step S10 when all m actual routes CRy have been assigned in this way.

Second exemplary embodiment

A second exemplary embodiment for setting up the actual route CRy is described below with the position method in the normal mode. In contrast to the first exemplary embodiment, it is not the case that four empty positions for actual routes CRy are to be newly assigned but rather a redistribution is to be set up by means of a newly added signaling line group. The intention is once more that the load distribution in the signaling network should be optimum.

According to the second exemplary embodiment, the destination address (DPC) 6000 has the active actual route CRy according to table 8.

Table 8

CR1	CR2	CR3	CR4
link set 3	link set 20	link set 4	link set 20

According to table 8, the signaling line group LS20 (link set 20) is used both for the actual route CR2 and for CR4. The instantaneous route meters used as the basis are obtained as follows from table 9.

5

Table 9

Route meter LSx	y = 1 C(LSx,1)	y = 2 C(LSx,2)	y = 3 C(LSx,3)	y = 4 C(LSx,4)	C_Sum/m (number m CRs = 4) Csetp (LSx)
. . . . .					
. . . . .					
link set 3	5	5	5	5	5
link set 4	6	5	5	5	5.25
. . . . .					
link set 20	12	13	14	14	13.25
. . . . .					
link set 50	3	4	3	2	3
. . . . .					
. . . . .					

In the second embodiment, the signaling line
10 group 50 is additionally available for the destination address (DPC) 6000. The result of another load distribution rule (not described in this case) is, for example, that the signaling line group LS20 which occurs twice is to be replaced either at position CR2
15 or CR4 by the signaling line group LS50. For the load distribution rule according to the invention, the precise position will now be determined in order to improve a load distribution in the signaling network. According to the calculation described above for the
20 absolute and relative deviation, the selection matrix represented in table 10 is obtained.

Table 10

```
[DELTA C(LS20,1) = +1.25    Delta Crel (LS20,1) = +0.09]    (*1)
 DELTA C(LS20,2) = +0.25    Delta Crel (LS20,2) = +0.02
[DELTA C(LS20,3) = -0.75    Delta Crel (LS20,3) = -0.06]    (*1)
 DELTA C(LS20,4) = -0.75    Delta Crel (LS20,4) = -0.06


[DELTA C(LS50,1) = 0        Delta Crel (LS50,1) = 0]        (*1)
 DELTA C(LS50,2) = -1       Delta Crel (LS50,2) = -0.33
[DELTA C(LS50,3) = 0        Delta Crel (LS50,3) = 0]        (*1)
 DELTA C(LS50,4) = +1       Delta Crel (LS50,4) = +0.33
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Here, the values denoted by *1 for the actual routes CR1 and CR3 are no longer taken into account because only the actual routes CR2 and CR4 are candidates for the application of the load distribution rule.

A peripheral condition here is: because the signaling line group LS20 (link set 20) is replaced, load can only be reduced for it (-). Because, in addition, the signaling line group LS50 (link set 50) is to be newly added, load can only be added for it (+).

This results in the following consideration of the relative deviations

1. The relative deviation Delta Crel (LS20,2) = +0.02 cannot be used because in fact a load is to be added at this point in accordance with the value (+), but according to the stipulation only a reduction is possible for the signaling line group LS20.

2. The relative deviation Delta Crel (LS20,4) = -0.06 provides a possible way of reducing the load, and is thus a candidate for the following consideration.

3. The relative deviation Delta Crel (LS50,2) = -0.33 is unsuitable for the following consideration because according to the value (-) in fact a load should be reduced here, but according to the stipulation only addition is possible for the signaling line group LS50.

4. The relative deviation Delta Crel (LS50,4) = +0.33 provides, on the other hand, a possible way of adding a load, and thus constitutes a candidate for the following consideration.

There thus remain two candidates for modification, the greatest relative deviation Delta Crel (LS50,4) = +0.33 being used. This means that the signaling line group LS20 is replaced at the position CR4 by the signaling line group LS50, as a result of which the load distribution in the two signaling line groups is improved. The variance is improved here in a way similar to that in the first exemplary embodiment.

Third exemplary embodiment

A third exemplary embodiment for setting up an actual route in accordance with a quantity method is described below.

According to the third exemplary embodiment, a case will now be considered in which a signaling line group (LS20) drops out completely and has to be replaced for a plurality of destination addresses.

The destination addresses (DPC) 8000, 8100 and 8200 are reached, for example, via the signaling line groups LS3, LS4, LS20 and LS50 according to figure 1. The table 11 shows the associated active actual routes CRy.

Table 11

DPC 8000:	CR1	CR2	CR3	CR4
	link set 3	link set 20	link set 4	link set 50

DPC 8100:	CR1	CR2	CR3	CR4
	link set 3	link set 20	link set 4	link set 50

DPC 8200:	CR1	CR2	CR3	CR4
	link set 3	link set 20	link set 4	link set 50

The instantaneous summation meters which are used as the basis are assumed to be as follows according to table 12:

Table 12

Signaling line group LSx	C_Sum(LSx)
.....	
.....	
link set 3	3
link set 4	3
.....	
link set 20	3
.....	
link set 50	3
.....	
.....	

It will be assumed below that the signaling line group LS20 (link set 20) fails completely and is to be replaced as skillfully as possible in the destination addresses (DPC) 8000, 8100 and 8200. According to the load distribution rule from the quantity method, the smallest value of the summation meter

C_Sum(LSx) of all the signaling line groups LSx involved is determined.

Since all the summation meters are the same according to table 12, the first signaling line group LS3 is firstly taken as a replacement for the link set LS20. The summation meter C_Sum(LS3) for the signaling line group LS3 is thus incremented from 3 to 4, while the summation meter C_Sum(LS20) for the failed signaling line group LS20 is reduced from 3 to 2. The smallest value of the summation meter C_Sum(LSx) is then in turn selected for all the available signaling line groups. However, because the summation meters for both the signaling line group LS4 and the signaling line group LS50 are again of equal size (3), the signaling line group LS4 is used as a further replacement for the failed signaling line group LS20.

The value of the summation meter C_Sum(LS4) for the signaling line group LS4 is thus incremented by 1, while the corresponding summation meter C_Sum(LS20) for the signaling line group 20 is in turn reduced by 1. Finally, the actual routes CRy for the destination address (DPC) 8200 are updated in the same way as for the destination addresses 8000 and 8100. The smallest sum value C_Sum(LSx) of all the signaling line groups involved is now 3 and is assigned to the signaling line group LS50, for which reason LS50 is used as a replacement for the signaling line group 20 in the destination address 8200. The new values of the summation meter C_Sum(LSx) now all have the value 4, while the summation meter C_Sum(LS20) for the failed signaling line group LS20 has the value 0.

Figure 3 shows an associated flowchart of a method for improving a load distribution in a signaling network according to the third exemplary embodiment.

According to figure 3, the meters used for selecting an actual route are initialized in a step S11

using the quantity method. In a step S12, a loop is carried out for all the destinations, the method being terminated in a step S18 only when all the destinations or destination addresses (DPC) have been processed. In a step S13, a loop is carried out for all the signaling line groups LSz in possible routes PRz to the respective destination. To be more precise, in the loop according to step S13, all the possible signaling line groups for possible routes PRz to a specific destination are read out of a database and checked in a subsequent step S14 to determine whether the possible signaling line group LSz can be used as an actual route CRy. If the result of the check is that the possible signaling line group LSz can in fact be used as an actual route CRy, an associated summation meter C_Sum(LSx) is read out in a step S15. The summation meter C_Sum(LSx) indicates here the number of respectively used signaling line groups LSx for the various destination addresses. In the event of the check in step S14 being negative, the method skips the reading out of the summation meter C_Sum(LSx). Then, for both cases the loop according to step S13 is carried out for the next possible signaling line group LSx to the predetermined destination. If, according to step S13, all the summation meters C_Sum(LSx) have been implemented for all the possible signaling line groups LSz, in a step S16 a selection of the signaling line group LSx with the smallest value of an associated summation meter C_Sum(LSx) is made for the actual route. Then, in a step S17, the summation meter of the selected signaling line group LSx and/or of an associated failed signaling line group LSx is incremented or decremented. After the step S17, the method repeats the steps following the loop S12 until the active actual routes CRy of all the destination addresses have been updated, and the method ends in a step S18.

According to the first and second exemplary embodiments described above, an optimum load distribution is obtained for different actual routes CRy in a respective signaling line group LSx. On the

5 other hand, according to the third exemplary embodiment, an optimum load distribution is obtained between the signaling line groups LSx used for predetermined destination addresses. In order to improve further the load distribution in a signaling

10 network, the exemplary embodiments described above can therefore also be combined with one another, as a result of which an improved load distribution is obtained both among the signaling line groups LSx used and within the active actual routes CRy.

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Fourth exemplary embodiment

Figure 4 shows a flowchart of a method for improving a load distribution in a signaling network

20 according to a fourth exemplary embodiment, the exemplary embodiment described above being combined with one another.

According to Figure 4, in a step S20, the meters used for setting up an actual route with

25 position method and quantity method are initialized. In a step S21, a loop is switched for all the destinations or destination addresses DPC which are to be reached or are desired. In this loop, a subroutine 22 in which the signaling line group which is loaded the least is

30 selected with the quantity method is subsequently carried out. The subroutine U22 corresponds here essentially to the method according to the third exemplary embodiment (figure 3). After the actual routes have been selected with the quantity method in

35 the subroutine U22, an actual route is set up with the position method in a subroutine U23. The subroutine U23 corresponds here essentially to the method described above in accordance with the first or second exemplary

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embodiment, and is therefore not described in more detail below. After the loop is processed in accordance with step S21, an optimum load distribution is made in accordance with the position method and quantity method, and the method ends in a step S24.

The invention has been described above with reference to a CCS7 signaling network. However it is not restricted to this and can also be applied to other signaling networks in which it is not permitted to change the values in the signaling route selection fields (SLS fields) of the message signaling units MSU.

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